

**U.S.ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL ANALYTICAL RADIATION ENVIRONMENTAL LABORATORY  
540 S. MORRIS AVE., MONTGOMERY, AL 36115  
TH ANALYSES**

**REPORT OF SAMPLE DELIVERY GROUP #1900153**

Project: Canadian Radium and Uranium 9/19  
Analysis method: Actinides (Thorium) by Extraction Chromatography  
Report ID: 1900153-TH  
Report type: Original  
Date reported: 10/31/2019  
Total pages in report: 11

**SAMPLES**

NAREL Sample #	Client Sample ID	Location	Matrix	Date Collected	Date Received
B9.10556G	RB-190908	NY:MT. KISCO	WATER	09/08/2019	09/10/2019
B9.10557H	RB-190909	NY:MT. KISCO	WATER	09/09/2019	09/10/2019

**EXCEPTIONS**

1. **Packaging and shipping** – No problems were observed.
2. **Documentation** – No problems were observed.
3. **Sample preparation** – No problems were encountered.
4. **Analysis** – No problems were encountered.
5. **Holding times** – No holding times were specified.

**QUALITY CONTROL**

1. **QC samples** – All QC analysis results met NAREL acceptance criteria.
2. **Yields** – All chemical yields were within acceptance limits.
3. **Instruments** – Response and background checks for all instruments used in these analyses met NAREL acceptance criteria.

**OTHER INFORMATION**

Since the  $^{230}\text{Th}$  and  $^{229}\text{Th}$  peaks can be difficult to resolve because of their proximity to each other, the alpha spectrometry analyst examines each spectrum closely and adjusts the regions of interest manually when a shift of the tracer peak is observed or when necessary to improve the separation between clearly identifiable peaks. Such manual adjustments are always documented.



## ACCREDITATION




NAREL is accredited by the Oregon Environmental Laboratory Accreditation Program (ORELAP) to the TNI standard. NAREL maintains accreditation for all its radiological analyses except the following:


- Analyses of drinking water
- Gross alpha and gross beta of solid matrices, including swipes
- Tritium analysis of solid matrices, including swipes
- Analyses for Ra-226 by method NAREL RA-07-EC
- Analyses for Am-241 by method NAREL ACT-02F
- Curium-244/243

## CERTIFICATION

I certify that this data report complies with the terms and conditions of the Project Acceptance Form and/or the Quality Assurance Project Plan, except as noted above. Release of the data contained in this report has been authorized by the Director of the Center for Environmental Radioanalytical Laboratory Science and the NAREL Quality Assurance Manager, or their designees, as verified by the following signatures.

  
\_\_\_\_\_  
Velinda Herbert  
Quality Assurance Manager, NAREL

11/5/19  
\_\_\_\_\_  
Date

  
\_\_\_\_\_  
Cynthia White  
Director, Center for Environmental Radioanalytical  
Laboratory Science

11-5-19  
\_\_\_\_\_  
Date

If you have questions about the data, please contact Cynthia White (cwhite@narel.org).



## GENERAL INFORMATION

### SAMPLE TYPES

BLD	Blind sample
FBK	Field blank
SAM	Normal sample

### ANALYSIS QC TYPES

ANA	Normal analysis
DUP	Laboratory duplicate
LCS	Laboratory control sample, or blank spike
LCX	Laboratory control sample duplicate
MS	Matrix spike
MSD	Matrix spike duplicate (not currently analyzed)
RBK	Method blank
STD	External standard (used for $^{228}\text{Ra}$ yield determination)

### QUALITY INDICATORS

RPD	Relative Percent Difference
%R	Percent Recovery
Z	Number of standard deviations by which a QC measurement differs from the expected value

### RADIOCHEMICAL DATA

Radiochemical analyses usually require the subtraction of an instrument background measurement result from a gross sample measurement result. Both values are positive, but when the sample activity is low, random variations in the two measurements can cause the gross value to be less than the background, resulting in a measured activity less than zero. Although negative activities have no physical significance, they do have statistical importance, as for example in the evaluation of trends or the comparison of two groups of samples.

To the extent practical, it is the policy of NAREL to report results as generated, whether positive, negative, or zero, together with the “2-sigma” measurement uncertainty and a sample-specific estimate of the minimum detectable concentration (MDC). The measurement result, uncertainty, and MDC are always expressed in the same unit of measurement.

### EVALUATION OF QC ANALYSES

A method blank result is considered unacceptable if it is more than 3 standard deviations below zero or more than 3 standard deviations above a predetermined upper control limit. For some analyses NAREL has set the upper control limit at zero. For others the control limit is a small positive number.

NAREL evaluates the results of duplicate and spike analyses using “Z scores.” A Z score is the number of standard deviations by which the QC result differs from its ideal value. Generally the score is considered acceptable if its absolute value is not greater than 3.

The Z score for a spiked sample is computed by dividing the difference between the measured value and the target value by the combined standard uncertainty of the difference. The Z score for a duplicate analysis is computed by dividing the difference between the two measured values by the combined standard uncertainty of the difference.

NAREL reports the “relative percent difference,” or RPD, between duplicate results and the “percent recovery,” or %R, for spiked analyses, but does not use these values for evaluation of most analyses. An exception is the use of %R in the evaluation of gross alpha matrix spike results. A gross alpha matrix spike result is considered acceptable if either  $|Z| \leq 3$  or  $60 \leq \%R \leq 110$ .



# Chain of Custody Forms

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USEPA

Date Shipped: 9/9/2019

Carrier Name: FedEx

Airbill No: 7761-9090-7836

## CHAIN OF CUSTODY RECORD

Canadian Radium & Uranium Corp/NY

Contact Name: Bernard Nwosu

Contact Phone: 909-585-2980

No: 2-090919-0032-0030-0001

Lab: NAREL

Lab Contact: Tonya Hudson

Lab Phone: 343-270-3433

Lab #	Sample #	Location	Matrix	Analyses	Sample Date	Sample Time	Numb Cont	Container	Preservative	Lab
	RB-190908	RB-190908	Blank	Alpha Spec (U, Th) & Gamma Spec	9/8/2019	16:00	4	1 L poly	HNO3 pH<2	N
	RB-190909	RB-190908	Blank	Alpha Spec (U, Th) & Gamma Spec	9/9/2019	09:00	4	1 L poly	HNO3 pH<2	N
<i>Signature</i>										

Special Instructions: Please email results to s.sumbaly@westonsolutions.com and ben.nwosu@westonsolutions.com. Samples to be run for isotopic Radium via NAREL ACT-02FTH, isotopic Uranium via NAREL ACT-02F-U, other gamma isotopes via NAREL GM-01-RA, and Radium-226 and Radium-228 via 21-day ingrowth, 60 day TAT.

SAMPLES TRANSFERRED FROM  
CHAIN OF CUSTODY #

Items/Reason	Relinquished by (Signature and Organization)	Date/Time	Received by (Signature and Organization)	Date/Time	Sample Condition Upon Receipt
All Samples All Analytes	<i>Signature</i> Bernard Nwosu (Weston)	9/9/19/16:00	<i>Signature</i> Tonya Hudson (NAREL)	9/10/19 09:20	sec page 1



**U.S. ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL ANALYTICAL RADIATION ENVIRONMENTAL LABORATORY**

**SDG #1900153**

**ANALYSIS SUMMARY**

Analysis method: NAREL TH-EICHROM  
Title: Actinides (Thorium) by Extraction Chromatography

NAREL Sample #	Client Sample ID	QC Type	Date Completed	Preparation Batch #	Assay Batch #
B9.10556G	RB-190908	DUP	10/18/2019	0016720Z	0024598Y
B9.10556G	RB-190908		10/18/2019	0016720Z	0024598Y
B9.10557H	RB-190909		10/18/2019	0016720Z	0024598Y
LCS-00785418K *		LCS	10/18/2019	0016720Z	0024598Y
RBK-00785417J *		RBK	10/18/2019	0016720Z	0024598Y

\* Samples marked with an asterisk are not in this sample delivery group but were analyzed with it for QC purposes.



**U.S. ENVIRONMENTAL PROTECTION AGENCY  
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**SDG #1900153**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B9.10556G	Amount analyzed:	2.000e-01 L
Client sample ID:	RB-190908	Preparation batch #:	0016720Z
Matrix:	WATER	Assay batch #:	0024598Y
Collected:	2019-09-08 16:00 EDT	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	SPK
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
10/17/2019 15:20	1000.0	AS81	CEB

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	DLC	MDC	Unit	Reference Date
Th227	0.00e+00	5.6e-02	3.5e-02	1.3e-01	PCI/L	10/17/2019 15:20 CDT
Th228	1.43e-02	5.6e-02	4.1e-02	1.1e-01	PCI/L	10/17/2019 15:20 CDT
Th230	-8.56e-02	1.5e-01	1.5e-01	3.2e-01	PCI/L	10/17/2019 15:20 CDT
Th232	2.13e-02	5.4e-02	3.3e-02	1.0e-01	PCI/L	10/17/2019 15:20 CDT



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**SDG #1900153**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B9.10556G	Amount analyzed:	2.000e-01 L
Client sample ID:	RB-190908	Preparation batch #:	0016720Z
Matrix:	WATER	Assay batch #:	0024598Y
Collected:	2019-09-08 16:00 EDT	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	SPK
Ash/dry weight:	N/A	QC type:	DUP
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
10/17/2019 15:20	1000.0	AS82	CEB

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	DLC	MDC	Unit	Reference Date
Th227	0.00e+00	5.5e-02	3.5e-02	1.3e-01	PCI/L	10/17/2019 15:20 CDT
Th228	-5.69e-03	5.8e-02	5.4e-02	1.4e-01	PCI/L	10/17/2019 15:20 CDT
Th230	-5.69e-02	1.6e-01	1.4e-01	3.2e-01	PCI/L	10/17/2019 15:20 CDT
Th232	1.59e-02	5.4e-02	3.7e-02	1.1e-01	PCI/L	10/17/2019 15:20 CDT



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**SDG #1900153**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B9.10557H	Amount analyzed:	2.000e-01 L
Client sample ID:	RB-190909	Preparation batch #:	0016720Z
Matrix:	WATER	Assay batch #:	0024598Y
Collected:	2019-09-09 09:00 EDT	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	SPK
Ash/dry weight:	N/A	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
10/17/2019 15:20	1000.0	AS83	CEB

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	DLC	MDC	Unit	Reference Date
Th227	0.00e+00	5.8e-02	3.7e-02	1.4e-01	PCI/L	10/17/2019 15:20 CDT
Th228	7.20e-02	8.6e-02	4.6e-02	1.3e-01	PCI/L	10/17/2019 15:20 CDT
Th230	-1.60e-02	1.6e-01	1.5e-01	3.2e-01	PCI/L	10/17/2019 15:20 CDT
Th232	1.17e-02	4.5e-02	2.7e-02	8.9e-02	PCI/L	10/17/2019 15:20 CDT



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**SDG #1900153**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	LCS-00785418K	Amount analyzed:	1.000e+00 SAMP
Client sample ID:	N/A	Preparation batch #:	0016720Z
Matrix:	N/A	Assay batch #:	0024598Y
Collected:	N/A	Prep procedure:	N/A
Sample type:	N/A	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	SPK
Ash/dry weight:	N/A	QC type:	LCS
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
10/17/2019 15:20	1000.0	AS84	CEB

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	DLC	MDC	Unit	Reference Date
Th227	3.69e-03	1.7e-02	1.1e-02	3.4e-02	PCI	10/17/2019 15:20 CDT
Th228	6.10e-03	1.3e-02	8.4e-03	2.4e-02	PCI	10/17/2019 15:20 CDT
Th230	2.08e+00	2.4e-01	2.9e-02	6.5e-02	PCI	10/17/2019 15:20 CDT
Th232	2.36e-03	9.1e-03	5.3e-03	1.8e-02	PCI	10/17/2019 15:20 CDT



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**SDG #1900153**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	RBK-00785417J	Amount analyzed:	1.000e+00 SAMP
Client sample ID:	N/A	Preparation batch #:	0016720Z
Matrix:	N/A	Assay batch #:	0024598Y
Collected:	N/A	Prep procedure:	N/A
Sample type:	N/A	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	SPK
Ash/dry weight:	N/A	QC type:	RBK
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
10/17/2019 15:20	1000.0	AS80	CEB

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	DLC	MDC	Unit	Reference Date
Th227	3.30e-03	1.5e-02	9.6e-03	3.0e-02	PCI	10/17/2019 15:20 CDT
Th228	-4.81e-03	1.6e-02	1.6e-02	3.7e-02	PCI	10/17/2019 15:20 CDT
Th230	-1.86e-04	3.3e-02	2.8e-02	6.3e-02	PCI	10/17/2019 15:20 CDT
Th232	-1.70e-03	6.2e-03	6.1e-03	1.9e-02	PCI	10/17/2019 15:20 CDT



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**SDG 1900153**

**PREPARATION BATCH SUMMARY**

Preparation batch #: 0016720Z  
Analysis method: NAREL TH-EICHROM  
Preparation procedure: N/A

NAREL Sample #	Client Sample ID	Analysis #	QC Type	Yield	$\pm 2 \sigma$ Uncertainty	Analyst
B9.10556G	RB-190908	00783919U		96.89 %	8.42 %	SPK
B9.10556G	RB-190908	00785419L	DUP	94.88 %	8.18 %	SPK
B9.10557H	RB-190909	00783923P		94.18 %	8.30 %	SPK
LCS-00785418K *		00785418K	LCS	92.00 %	8.11 %	SPK
RBK-00785417J *		00785417J	RBK	105.78 %	8.91 %	SPK

\* Samples marked with an asterisk are not in this sample delivery group but were analyzed with it for QC purposes.

**QC RESULTS FOR BATCH 0016720Z**

NAREL Sample #	Analysis #	QC Type	Analyte	%R	RPD	Z	Evaluation
B9.10556G	00785419L	DUP	TH227			0.00	PASS
B9.10556G	00785419L	DUP	TH228		463.9	-0.49	PASS
B9.10556G	00785419L	DUP	TH230		-40.3	0.26	PASS
B9.10556G	00785419L	DUP	TH232		28.9	-0.14	PASS
LCS-00785418K	00785418K	LCS	TH230	104.5		0.73	PASS
RBK-00785417J	00785417J	RBK	TH227				PASS
RBK-00785417J	00785417J	RBK	TH228				PASS
RBK-00785417J	00785417J	RBK	TH230				PASS
RBK-00785417J	00785417J	RBK	TH232				PASS